THE GEOLOGY AND PRODUCTION HISTORY OF THE STARLIGHT AND STARLIGHT EAST URANIUM MINES, NAVAJO COUNTY, ARIZONA

by

William n L. Chenoweth
Consulting Geologist, Grand Junction, Colorado

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Arizona Geological Survey
416 W. Congress, Suite #100, Tucson, Arizona 85701

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INTRODUCTION

The Starlight and Starlight East Mines were two of fifteen uranium deposits located by exploration drilling in the Oljeto syncline area of Monument Valley, Navajo County, Arizona. Of all the deposits that were mined, the Starlight East was the fourth largest and the Starlight was the fifth largest. In his compilation of data of uranium in Arizona, Scarborough (1981, p.225) did not separate the ore production of these two separate mines.

Most of the information in the this report is from U. S. Atomic Energy Commission (AEC) documents. Unfortunately, no maps of the mine workings could be located. This report is the last of the series on uranium mines in the Monument Valley area of Navajo County, Arizona (See Appendix 1).

LOCATION AND LAND STATUS

The Starlight and Starlight East Mines were approximately 17 miles north of Kayenta, Arizona and 5 miles west of U. S. Highway 163 (Figure l). The two mine sites have been reclaimed, but the mine shaft location of the Starlight Mine is shown on the Boot Mesa topographic map (U.S. Geological Survey, 1988) at latitude 36° 57' 25" north and longitude 110° 18' 52" west.

The mine was within the Navajo Indian Reservation. Mining permits and leases were issued by the Navajo Tribal Council and approved by the Bureau of Indian Affairs (BIA), U. S. Department of the Interior. Mining permits could be obtained by individual Navajos only. Permit holders could assign the mining rights to another individual or a company; like the permits, these assignments had to be approved by the Tribal Council and the BIA. Leases could be issued directly by the BIA. Permits were issued for a 2-year period and could be renewed for an additional 2 years. Leases were issued for periods up to 10 years. No more than 960 acres of tribal land could be held by any one company or individual. Both the permittee and the tribe received royalties for ore production. Based on the mine value of the ore, the tribe received between 10% and 20% royalties and the permittee between 2% and 5% royalties.

In addition to mining permits, the tribe issued drilling and exploration permits. These permits were good for 120 days and were not renewable.

GEOLOGICAL SETTING

The Starlight and Starlight East ore deposits on the Starlight Nos. 1-3 claims were two of fifteen uranium ore deposits that were located by "blind" drilling in the El Capitan Flat area of Monument Valley. The Flat is a large, sand-dune-covered area on the eastern side of Oljeto Wash (Figure 1). Oljeto Wash roughly follows the axis of the Oljeto syncline, which is between the Organ Rock anticline to the west and the crest of the Monument Uplift to the east. Underlying the dune sand in the Starlight area is the Upper Triassic Chinle Formation. Rocks of this formation dip approximately 2° to the west into the syncline (Witkind and Thaden, 1963).

The ore bodies on the Starlight and adjacent Daylight claims were formed in channel deposits in the basal portion of the Shinarump Member of the Chinle Formation. The channel at the Starlight Mine approximately 200 feet wide and has a maximum depth of approximately 100 feet, was scoured into the underlying Moenkopi Formation of Lower Triassic age and filled with medium-to-coarse-grained sandstone and conglomerate. Carbonaceous plant materials, including fossil logs, are abundant in the channel sediments.

Geologic investigations by Kenneth S. Hatfield of Kerr-McGee Oil Industries, Inc., indicated that the channel at the Starlight East Mine generally had a flat floor, but was somewhat undulating (written communication, 1996). The ore lies along the banks of the channel, but crosses the channel where it is shallow (Figure 2).

Geological studies of the Shinarump channels in Monument Valley, based largely on industry drilling, by Young and others (1964) indicate the Daylight deposit occurs at the junction of the southwest trending channel containing the Moonlight Mine and the north, northwest channel containing the Sunlight and South Sunlight Mines. At the Daylight the combined channel spits into two segments with the Starlight East Mine formed in the southern segment. The Starlight Mine is located at the confluence of the two segments (Figure 3).

The Starlight deposits were unoxidized due to a perched water table in the basal Shinarump. When the Starlight Mine was fully developed, ground water was entering the mine at the rate of 50 gallons per minute (John Borkert, personal communication, 1993). Uraninite (uranium oxide) was the principal uranium minerals. Montrosite, a vanadium oxide, was also present, as were copper sulfides such as bornite, chalcocite, and chalcopyrite. Calcium carbonate ($CaCO_3$) was the principal cementing agent of the sandstone.

Data compiled by Roger C. Malan, of the AEC, for his published report on Monument Valley (Malan, 1968) indicated that 40,000 tons of ore shipped from the Starlight Mines averaged 0.30 percent copper (Cu).

EXPLORATION HISTORY

During 1955, numerous Navajos acquired permits to hold land for mining on the sand-covered flats along El Capitan Wash, on the eastern flank of the Oljeto syncline. They applied for these permits in anticipation of exploration drilling that was to be done by companies looking for uranium deposits farther north, near the axis of the syncline. By early 1956, more than 25 square miles on the eastern flank of the Oljeto syncline were claimed by mining permits. Because of confusion and conflicts over permits, the large area west of Oljeto Wash was withdrawn for prospecting and mining by the Navajo Tribal Council on July 19, 1955 (Navajo Tribal Council, 1955).

On July 18, 1955, Vern Salt was issued Navajo Tribal Mining Permit No. 306 for the Daylight Nos. 1-4 claims. Seth T. Bigman was issued Mining Permit No. 354 for the Starlight No. 1 and 2 claims on September 16, 1955. On the same day, Buck Austin was granted Mining Permit No. 353 for the Starlight Nos. 3 and 4 claims. Each of the claims contained 160 acres (Figure 4).

Industrial Uranium Company, Salt Lake City, Utah, obtained a drilling permit for the area of the Starlight and Daylight claims and did exploration drilling in the area. Having been successful in locating some ore bodies, the company applied for the assignment of the mining rights to the permits in January 1956. The assignment of 61.2 acres of the Daylight claims and 67.2 acres of the Starlight Nos. 1 and 2 claims was approved on May 17, 1956. The assignment of 40 acres of the Starlight No. 3 claim was approved on September 4, 1956. The assignment of the 61.2 acres of the Daylight claims included a 200 foot wide right of way across the claims to the area of the Sunlight Mine (Figure 4).

Since Industrial Uranium had located significant ore bodies they applied to the Secretary of the Interior in October 1956 to convert their mining permits to 10-year leases. On June 27, 1957, Mining Leases Nos. 14-20-603-2289, 14-20-603-2290 and 14-20-603-2292 were approved for the Starlight No. 1 and 2, Daylight Nos. 1-4 and the Starlight No. 3, respectively (Figure 4).

STARLIGHT MINE

Data in the AEC files indicates the Starlight Mine was discovered by 99 drill holes with a total footage of 15,840 feet. This drilling delineated an estimated 65,000 tons of ore with an average grade of 0.30 percent U_3O_8 at a depth of 170 feet. Early in 1957, Industrial Uranium began sinking a 190 feet, two compartment shaft. When the operation was visited by the State Mine Inspector on August 15, 1957, six men were employed sinking and timbering the shaft. The shaft was equipped with a 2 ton, 50 horsepower, single drum, steam converted to electric hoist (U.S. Atomic Energy Commission, 1959). The State Mine inspection reports indicate 20 to 23 men

were employed underground and 4 to 5 men worked on the surface during 1958 and 1959 at the Starlight. Two shifts were used at the mine. Modified room and pillar mining was used with track haulage below the ore zone. The ore at the Starlight averaged two feet thick.

On November 21, 1957 a 197.5 ton amenability shipment was made to the mill at Mexican Hat, Utah, operated Texas-Zinc Minerals Corporation. This shipment was assayed at 0.48 percent U_3O_8 , 0.35 percent V_2O_5 and 8.10 percent $CaCO_3$. Sustained production began in January 1958 with all shipments going to the mill at Tuba City, Arizona operated by Rare Metals Corporation of America. Industrial Uranium had a contract with Rare Metals to supply up to 2,000 tons per month of Starlight ore. The hauling distance from the mine to the mill was 85 miles.

The Starlight Mine closed in the fall of 1958 after producing 16,551.80 tons of ore averaging 0.30 percent U_3O_8 (Table 1). Some 9,148.77 tons were analyzed for vanadium which averaged 0.53 percent V_2O_5 (Table 2). The mine reopened in May 1959 with all further shipments going to the Mexican Hat mill of Texas-Zinc Minerals. The hauling distance from the mine to this mill was 32 miles. Copper in uranium ores was recovered at this mill.

Production in 1960 averaged approximately 700 tons per month and in 1961 was nearly 1,000 tons per month. Mine inspector reports indicated that between 10 and 15 men were employed underground and from 2 to 4 men were on the surface during 1960 and 1961.

When the Starlight Mine closed in late 1961 it had produced 40,378.25 tons of ore averaging 0.29 percent U_3O_8 and containing 231,730.52 pounds U_3O_8 (Table 1). These pounds rank the Starlight as the fifth largest mine in the Oljeto syncline, behind the Moonlight, Bootjack, Sunlight and Starlight East Mines.

STARLIGHT EAST MINE

In August 1960, Industrial Uranium Company announced that the company had discovered a 50,000 ton ore body which would replace the Starlight production when that deposit was depleted. The new mine, to be know as the Starlight East, would be developed by a 450 foot long decline.

Production began in 1961 with all the ore being shipped to the Mexican Hat mill (Table 3). The mine was developed using modified room and pillar methods with rubber-tired diesel equipment used underground for loading and transporting ore. State Mine Inspector reports indicate that during the years 1961-1963, an average of 16 men worked underground and 2 men worked on the surface.

Beginning in 1962 ore was shipped to Tuba City as part of Industrial's 400 ton per month contract with Rare Metals Corporation of America. These shipments continued through May 1962, when the mill stopped purchasing ore (Albrethsen and McGinley, 1982). After the mill closed, all shipments resumed to Mexican Hat. On July 31, 1963, the Atlas Corporation purchased Texas-Zinc Minerals. An Atlas subsidiary, A-Z Minerals, operated the Mexican Hat mill until it closed in February, 1965 (Albrethsen and McGinley, 1982).

When the Starlight East Mine closed in early 1964, it had produced 45,990.38 tons of ore averaging 0.31 percent U_3O_8 and containing 289,377.67 pounds U_3O_8 (Table 3). These pounds rank this mine as the fourth largest in the Oljeto syncline, behind the Moonlight, Bootjack, and Sunlight Mines.

DAYLIGHT DEPOSIT

During exploration drilling on the Starlight and Daylight claims, Industrial Uranium Company discovered an ore body on the Daylight No. 1 claim (Figure 4). It was reported to contain 20,000 tons of ore averaging 0.19 percent U_3O_8. Due to the low grade it was never mined.

SUMMARY

All of the uranium concentrate produced at the Mexican Hat and Tuba City mills from the Starlight and Starlight East ores were sold to the AEC. Copper recovered at the Mexican Hat mill was sold to a smelter in Arizona. Vanadium was paid for at the ore-buying station at Tuba City but was not recovered (Albrethsen and McGinley, 1982).

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Tables

Table 1. Uranium ore production, Starlight Mine - Navajo County, Arizona

Year	Tons of Ore	Pounds U_3O_8	Percent U_3O_8	Delivery Point
1958	16,551.80	100,765.43	0.30	Tuba City
1959	4,166.90	31,011.01	0.37	Mexican Hat
1960	8,040.22	35,724.13	0.22	Mexican Hat
1961	11,619.25	64,229.93	0.28	Mexican Hat
Total:	40,378.25	231,730.52	0.29	

Table 2 Vanadium content of uranium ores, Starlight Mine - Navajo County, Arizona

Year	Tons of Ore	Pounds U_3O_8	Percent U_3O_8	Delivery Point
1958	9,148.77	96,977.37	0.53	Tuba City

Table 3. Uranium ore production, Starlight East Mine - Navajo County, Arizona

Year	Tons of Ore	Pounds U_3O_8	Percent U_3O_8	Delivery Point
	11,552.85	79,422.92	0.34	Mexican Hat
	18,757.27	113,314.36	0.30	Mexican Hat, Tuba City
1963	14,471.09	88,385.84	0.31	Mexican Hat
1964	1,209.17	8,254.55	0.34	Mexican Hat
Total:	45,990.38	289,377.67		

All shipments made by the name of Industrial Uranium Company

Source: Unpublished ore production records, U.S. Atomic Energy Commission, Grand Junction, Colorado

List of Figures

APPENDIX 1. List of Uranium Mine reports, Monument Valley, Arizona

Name of Mine	Contributed Report No.
Alma	CR-94-C
Big Chief	CR-92-D
Big Four 2	CR-94-G
Black Rock	CR-91-A
Bootjack	CR-93-A
Fern 1	CR-94-A
Firelight 6	CR-92-C
Golden Crown	CR-95-F
Harve Black 2	CR-89-E
Mitchell Butte	CR-95-B
Mitten 2	CR-92-A
Moonlight	CR-95-D
Monument 1	CR-92-A
Sally	CR-91-A
Sam Charlie 1	CR-95-C
Seegan	CR-94-C
South Sunlight	CR-97-A
Starlight	This Report
Starlight East	This Report
Sunlight	CR-97-A
Tract 11	CR-96-A
Tract 17	CR-96-A

APPENDIX 2. Legal Description Navajo Tribal Mining Permit No. 354

Starlight No. 1:

"Commencing at Cor. No. 1 which is the Northwest corner (Cor. No. 4) of Moonlight No. 2 Claim (M.P. No. 73) which lies S 31° 00′ E, 9390 feet and S 55°50′ W, 9386 feet from the corner common to Sec. 31 and 32, T43S, R15 E, S.L.B.& M., running thence S 38° 08′ W, 5280 feet to Cor. No. 2; thence N 34°10′ W, 1385 feet to Cor. No. 3; thence N 38°08′ E, 5280 feet to Cor. No. 4; thence S 34°10′ E, 1385 feet to beginning, containing 160 acres."

Starlight No. 2:

"Commencing at Cor. No. 1 which lies N 34°10′ W 1385 feet from Cor. No.4 Moonlight No. 2 Claim, above described, running thence S 38°08′ W, 5280 feet to Cor. No. 2; thence N 34°10′ W, 1385 feet to Cor. No. 3; thence N 38°08′ E, 5280 feet to Cor. No. 4; thence S 34°10′ E, 1385 feet to beginning, containing 160 acres."

Legal Description of Mining Lease No. 14-120-603-2289

"Beginning at the No. 3 corner of Starlight No. 2 Claim (Mining Permit No. 354), running thence North 38°08′ East 660 feet to Corner No. 2; thence South 55°55′ East 1,324 feet to Corner No. 3, which is on the S.E. sideline of said No. 2 Claim; thence South 82°08′ East 1,526 feet to Corner No. 4 on the S.E. Sideline of Starlight No. 1 Claim; thence South 38°08′ West 1,942 feet to Corner No. 5; thence North 51°52′ West 1,320 feet to Corner No. 6, which is the No. 3 corner of Starlight No. 1 Claim; thence North 38°08′ East 512 feet to Corner No. 7; thence North 55°55′ West 1,324 feet to point of beginning, containing 67.2 acres, and located in Navajo County, Arizona."

From the files of the Navajo Tribal Mining Department, Window Rock, Arizona.

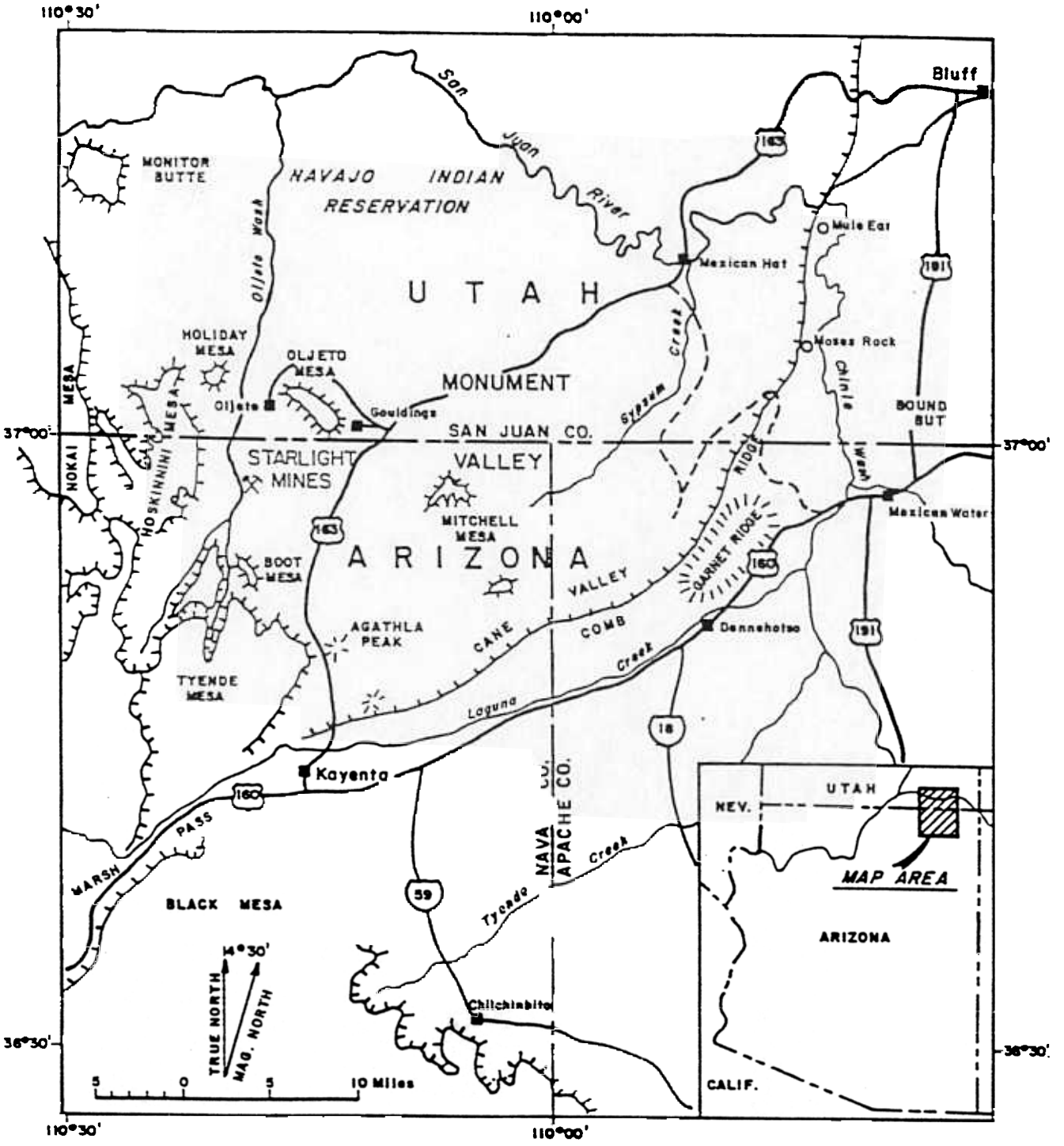

Figure 1. Index map of Monument Valley, Arizona-Utah, showing the location of the Starlight mines.

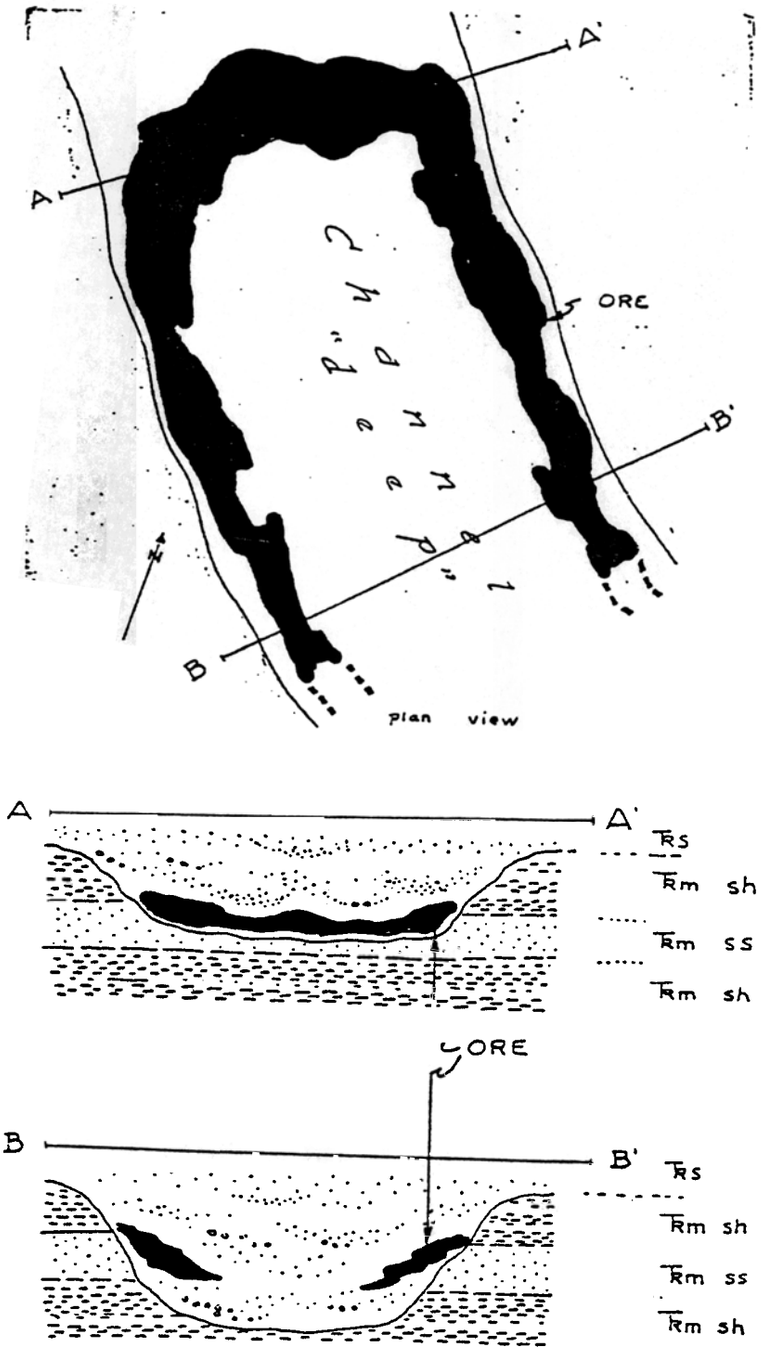

Figure 2. Plan and cross-sections of ore bodies, Starlight East Mine, Navajo County Arizona. Trs-Shinarump Mbr., Chinle Fm.; Trmsh-Moenkopi Fm., shale; Trmss-Moenkopi Fm., sandstone. Geology by K.G. Hatfield, 1961.

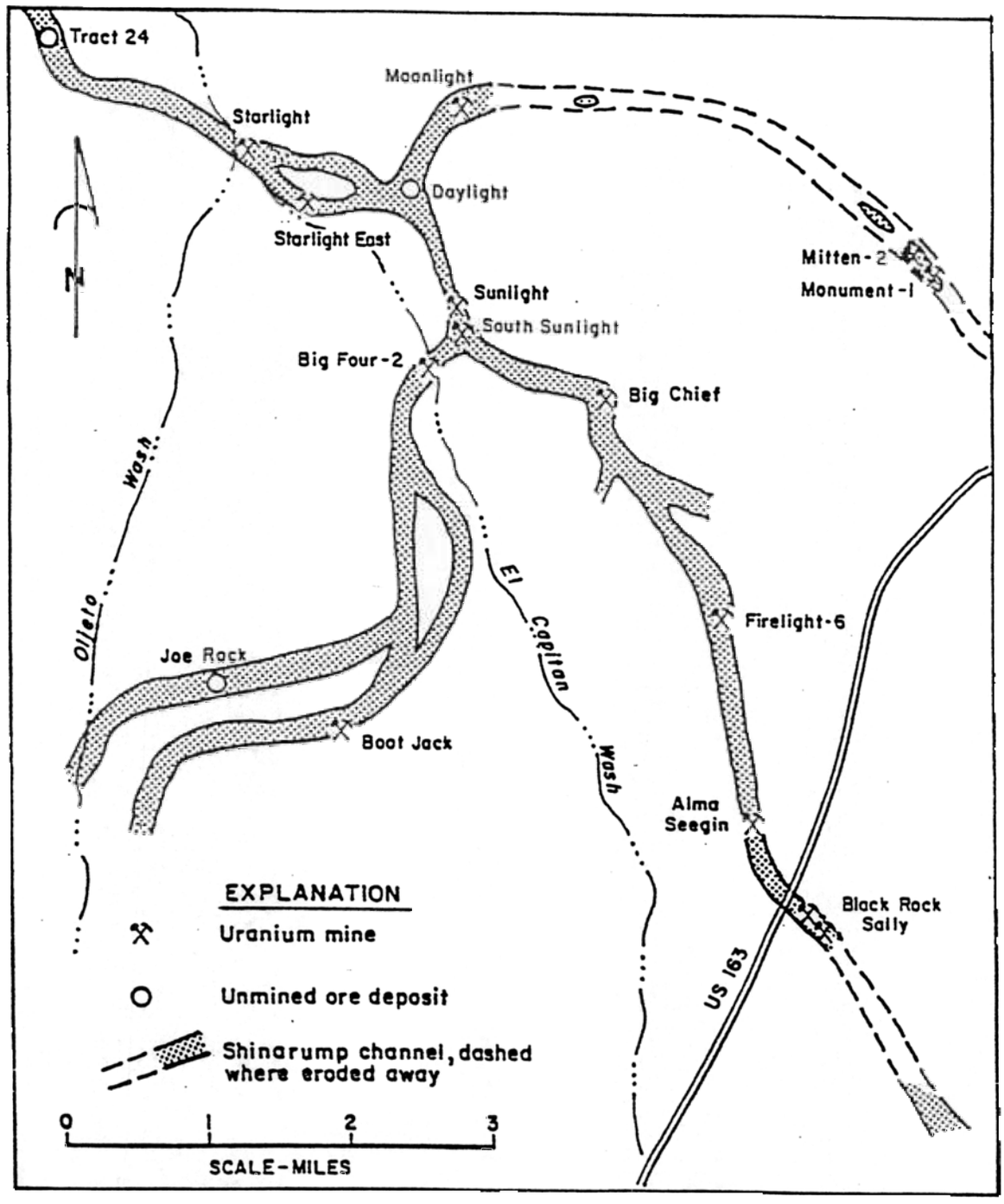

Figure 3. Map of the El Capitan Wash area, Navajo County, Arizona showing Shinarump channels and uranium deposits. After Young and others (1964).

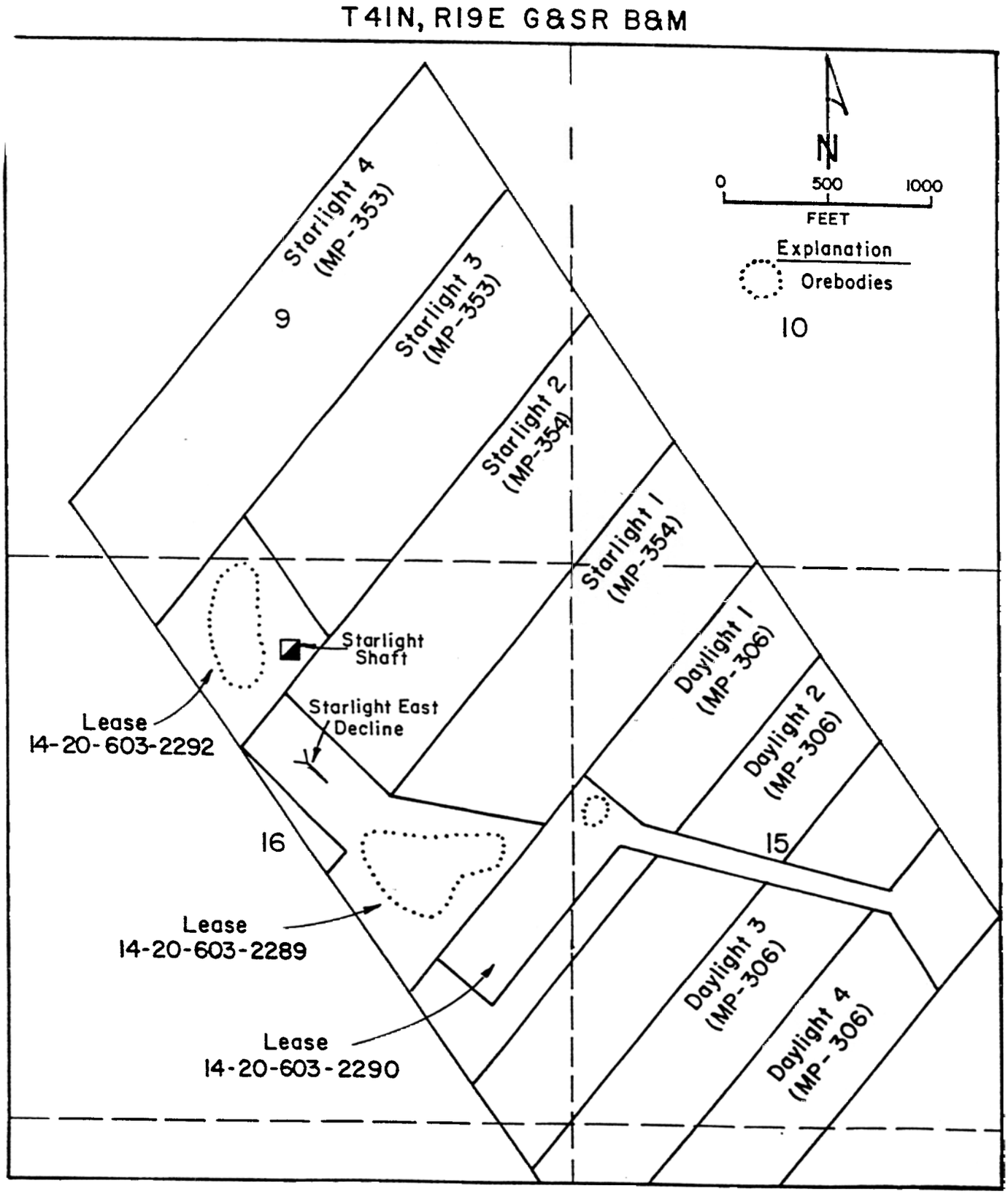

Figure 4. Index map showing the location of the Starlight and Daylight claims, Navajo County, Arizona, from AEC files. Ore bodies from John Borkert.